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Journal of the Society of Arts.

FRIDAY, JULY 12, 1861.

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COUNCIL.

Thursday, July 4th, 1861.

At the first meeting of the Council since their election, Sir Thomas Phillips, F.G.S., Vice-President, was unanimously elected Chairman for the current year.

The following Institution has been taken into Union since the last announcement:—

Poole, Mechanics' Institution.

INTERNATIONAL EXHIBITION OF 1862.

The Council beg to announce that the Guarantee Deed is now lying at the Society's House for signature, and they will be much obliged if thos egentlemen who have given in their names as Guarantors, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate to £424,700, have been attached to the Deed.

Meetings of the Metropolitan Exhibitors have taken place, and Class Committees for the Metropolis, in addition to those already published, have been appointed as follows:—

Class 3 (Substances used for Food).

Sub-class A (Exhibitors of Agricultural Produce): Mr. Chas. Woolloton, *Chairman* of Sub-committees, collectively and separately., Messrs. S. Ainsworth, W. Christie, W. E. Chambers, and A. Hall.

Sub-class B (Exhibitions of Drysaltery, Grocery, &c.): Messrs. C. Hewitt, Blackwell (Crosse and Blackwell), J. Broomhall, E. M. Nelson, W. E. Bartlett, W. J. Bellville, H. Schooling, H. Dodson, and R. Jones.

Sub-class C (Exhibitors of Wines, Spirits, Beer, and other Drinks and Tobacco), Messrs. H. P. Gilbey, J. L. Levitt, S. Mart, Dahlke, W. Gow.

Class 4 (Animal and Vegetable Substances used in Manufactures).

Sub-class A (Exhibitors of Oils, Fats, and Wax, and their Products): Messrs. T. M. Smith, B. B. Turner, Jno. Cunnington, W. W. Williams, and Lyner Neighbour.

Sub-class B (Exhibitors of other Animal Substances used in Manufactures): Messrs. G. Darney, W. Buxton, Marcus Samuel, W. W. Jewesbury, and Chas. Farlow.

Sub-class C (Exhibitors of Vegetable Substances used in Manufactures, &c.): Dr. Collyer, M.D., Messrs. Hancock, R. Fauntleroy, Thos. Treloar, and E. Hyde.

Class 17 (Surgical Instruments and Appliances):—(Surgical Instrument Makers), Messrs. R. Williams, Coxeter, Simpson, Matthews, and Rein; (Surgical Bandage Makers and Anatomical Machinists), Messrs. Bigg, Grossmith, and Ferguson; (Dentists and Dental Instrument Makers), Messrs. Hallam, Harnett, and A. Gabriel.

Class 20 (Silk and Velvet):—Messrs. R. Harrison, Stone, D. Keith, P. A. Taylor, S. Lewis, J. Snelgrove, and S. Hicks, with power to add to their number.

Class 29 (Educational Works and Appliances): Sub-class A (Publishers), Messrs. W. H. Cremer, Sen., Darton, and E. Stanford (*Chairman* pro tem.)

Sub-class B (Apparatus Manufacturers): Mr. C. K. Wylde (firm of Reeves and Sons), Capt. Morrison, R.N., and Mr. B. Wright.

Sub-class C (Toy and Games Manufacturers): Messrs. Jacques, Mead, and Normand.

Class 32 (Steel and Cutlery), Messrs. S. J. Addis, G. Gallienne, E. T. Burgess, J. V. Hill, E. Mappin, J. N. Mappin, and Matthews.

Class 36 (Manufactures not included in previous classes), Messrs. Asprey, Leuchars, West, Allen, Southgate, Bazin, and Gale.

The following Foreign Commissions have been appointed, in addition to those already published:

Monte Video.

Dr. Don Manuel Herrera y Obes, *President.*
Don Xavier Alvarez, *Secretary.*

Norway.

Captain-Lieutenant Steenstrup, *Chairman.*
Baron H. Wedel, Jarlsburg.
Mr. H. Schon.
Mr. O. Pihl.
Mr. Schübeler.
Mr. H. Christie, *Secretary.*

Mr. E. Tidemand, of the Royal department of the Interior, will be sent to London to assist at the reception, arrangement, and return of the goods to be exhibited, and will generally take care of the interests of Norwegian Exhibitors.

Grand Duchy of Nassau.

The Central Authority for the Administration of the Interior will act as a Commission.

Bolivia.

Mons. A. Anthoine, of No. 2, Langham-place, London, W., has been appointed the medium of communication.

THE MANSFELD COPPER-SLATE MINES IN PRUSSIAN SAXONY.

By W. P. Jervis, F.G.S., Mining Engineer.

(*Continued from page* 598.)

Although as great in extent, the management of the mines at the commencement of the 16th century was very different from what it is now; ceasing to be worked by private persons, they were acquired by the counts. In 1536, the assembled counts resolved to divide the mines, formerly administered together, into five parts, three of which were shared among Counts Hoier, Günther, and Ernst, of the *Vorderort;* the others between Counts Albrecht and Gebhardt, of the *Hinter* and *Mittelort*:* the total number of the mining properties or *Feuer* was 95, that is 55 *Herrn* and 40 *Erbfeuer*. The *Vorderort* comprised 33 *Herrn* and 24 *Erbfeuer*, in Eisleben, Bornstedt, Mansfeld and Hergisdorf; the *Erbfeuer* were in the hands of the families Drachstedt, Fürer, Blankenberg, Pucker, Bruckner. To the *Hinterort* pertained 11 *Herrn* and 8 *Erbfeuer* in Gross Orner and Eisleben; the *Erbfeuer* were the property of the families Stahl, Fürer, and Beckmann. The *Mittelort* embracing the remaining 11 *Herrn* and 8 *Erbfeuer* in Eisleben, Wimmelburg, Mansfeld, and Leimbach; the *Erbfeuer* were in the possession of the families Drachstedt, Müller, and Memhardt. The central point of all these undertakings was the then flourishing town of Mansfeld, the size of which must have been much greater than now, to judge by the extent of the ruins.

It was a wintry November day, in the year 1483, when two poor peasants, Hans and his wife Margaret, who had trudged along all the way from Möhra, near Eisenach, in Thuringia, entered Eiseben to attend

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*** These terms expressed the part of Mansfeld castle occupied by the counts of each line, whether the front, back, or centre.**

the fair. Margaret sought a resting place at the hostelry, where almost immediately afterwards she gave birth to a son, whom she called Martin, after the patron saint of the day. The parents repaired the following year to Mansfeld, where Hans became a miner, and Margaret brought fire-wood on her back from the forest. With industry, frugality, and rectitude of conduct, they prospered visibly. Martin was first placed at the burgher school at Mansfeld, at the age of 5 years, and thence transferred to Magdeburg; meanwhile, from 1491 to 1502, Hans was placed on the magisterial bench at Mansfeld, and sent his little son to Eisenach. By his industry he was removed beyond the reach of want, and, no longer compelled to work with pick and gad, rented two *Herrnfeuer* smelting furnaces from the counts, and became a burgher; thus, in 1501, he was able to place Martin at the University of Erfurt, for he had a great passion for literature and sound knowledge, insomuch that he would associate with most the educated men in the town, and sought a distinguished position in the law for his boy. The dutiful son thus records the fact:—"My father, with deep love and affection, keeps me at the high school at Erfurt, and by the sweat of his brow has succeeded in getting me here."—Krumhaar. The writer of these touching lines, the miner's son, was no other than the great Martin Luther, and thus may we say that the Reformation sprang out of the depth of the Mansfeld mines. Nor was the Reformer unmindful of his birthplace, where he happily lived to see his work take root, the princes, (at least, nominally) embrace the principles of the Reformation, and order succeed to political jangle. Two large burrows are now pointed out close to Mansfeld as having been those produced by Hans Luther's metallurgical industry, which everybody knows as Luther's Halden.

Regarding the succession to the *Erbfeuer* the following clause was enacted: "Since part of the *Feuer* are given to the smelting masters in hereditary fief, our decree (*Ordnung*) enacts that we wish and intend that the hereditary proprietors should remain, nor will we oppress them on that account; in case that one of the *Feuer* should, by virtue of our *Bergordnung*, lapse to one of us, or that the smelting master should die without heirs, the count from whom he held it shall have the preference before other purchasers." This was drawn up in order to settle a feud between the litigious counts, but without success. In 1540, Philip, Duke of Brunswick; Wilhelm, Count of Neuenar; and Günther, Count of Schwartzburg, were made umpires in an affair relating to the charcoal trade. In 1541 a general meeting of the assembled counts was held, by which the chief management of all mining affairs was vested in two noble counsellors (*Rathen*), Wolf Schenk and Mark Stor; and four stewards, Oswald Müller, Hans Stahl, Wolf Pucker, and Pesch Rink; these had at their command eight directors (*Bergverwalter*) and four inspectors (*Geschworene*). Albrecht, resolving to pay off the debt as far as possible by better management and economy, sought with little or no indemnity to convert the eight *Erbfeuer*, given to him by the decree, into *Herrnfeuer*, and at the same time to circumscribe the powers of the smelting-masters placed in charge of the existing eleven *Herrnfeuer*. A feeling of discontent naturally followed this glaring act of oppression, which Luther felt himself called upon at once to quell by his personal authority. He urged his appeal in the gentlest manner. The following are his words:

"To the Most Noble and Highborn Lord, Albrecht, Count and Lord of Mansfeld, my Beloved and Gracious Sovereign.

"Grace and Peace in Christ!

"Most Gracious Lord,—For a long time I have not requested anything, yet now I must come once again lest the path of petition be overgrown with grass; but I most respectfully beg that your Grace will attend to my demand, that I may not be deterred and return with the notion that your Grace is unfavourable to me, knowing that I have not deserved such treatment. Here is the burden of my letter:—I was lately at the Court, whither, however, I care little to resort. In the course of conversation it was mooted by persons of high standing, who had no bias in the matter, but wished to point out the inevitable course of events, that your Grace had acted very severely towards the smelting masters, and that prosperity would finally be fairly banished from the county. Much was spoken regarding the cause of this, which I cannot forbear to point out. I thereupon inquired on what footing of friendship I stood, and was informed that my father-in-law Mackenroth had declared that these transactions would reduce his family to beggary. 'God forbid,' replied I, 'he has nothing save his mining property (*Erbfeuer*), and I pledge myself to write to my lord about it.' My father-in-law has not mentioned anything further to me about this affair, except that I once, in pure joke styled them smelting task-masters (*Schlackentreiber*) instead of smelting lords (*Schlackenherrn*); they smiled, saying that in a short time such an appellation would not be very inappropriate. Such are the remarks which dropped at the Court.

"I therefore pray that your Grace will grant me a great favour by acting the part of a lenient lord towards the good Mackenroths, and treat them mercifully, seeing that your Grace, though great and rich, cannot do anything with poor subjects, however good, but will rather draw down God's anger on yourself, for with Him it is but an easy matter to render the rich penniless, or to enrich the poor. I ask not for this as a right, since I neither know nor desire to fathom the merits of the case, but rather as an act of mercy and favour, since your Grace himself will need God's grace and mercy, as your Grace knows perfectly well. If we stand too strenuously to our rights at the hands of our neighbours, steeling our hearts against all compassion, God will also demand justice at our hands, nor allow his mercy any longer to beam on us. I hope that your Grace will not interpret anything further from this than that I regard your Grace as the beloved Sovereign of my country, and serve you with true fidelity; for which very reason I cannot suffer that anything harsh should be spoken relating to your Grace, far less can I have it on my conscience that I should dread that God's anger should descend upon your Grace without my warning your Grace in time. I solicit a favourable reply. God speed the matter. Amen!

"Your Grace's obedient,
"Martin Luther.

"Trinity Monday, 1540."

—(Walch., *Luther's Briefe*, xxi., p. 435.)

Luther also wrote to Duke Moritz, one of Albrecht's liege lords, saying that the latter ought to treat his subjects with more gentleness; that worldly power was bestowed on the nobility for the purpose of protecting the innocent and punishing the bad. To treat the people like dogs and swine was a sure proof that they despised God, the Christian faith teaching us that we should all honour each other as those who have been ennobled by the blood of Christ in an eternal kingdom, compared with which temporal nobility with such miserable worldly rank was a mere nothing. Should the nobility persevere in the course they had hitherto adopted in Germany, it would become worse there than among the Spaniards or Turks, but the tide would flow back on themselves.—(See Krumhaar, *Die Graffschaft Mansfeld in Reformations Zeitälter*, page 261.)

The strife became more terrible when Counts Philipp and Hans Georg, the representatives of the Vorderort, endeavoured to confiscate the 33 mining properties (*Herrnfeuer*) belonging to them as fiefs (*Lehen*). The intrepid Reformer was again at his post of conciliation, and, in 1542, he wrote to the two counts in unequivocal language, saying, that if they acted in this manner towards their dependents, taking possession of what was not their own, the higher gentry would imitate their example towards the lesser, and as the nobles treated the landed proprietors, the higher princes would act towards themselves and the nobility, since this was not the personal property of the Counts but vested in fief. Therefore, let Count Albrecht beware lest he consider the county and all its property as his own, for God will not suffer such a thing. The property of the nobility is subject to fiefs, according to imperial law, and consequently divine right. Whosoever shall assume to himself possessions accompanied by a fief cannot have God's blessing abiding on him, but directly infringes the commandment, "Thou shalt not steal." Although Count Albrecht is the sovereign of the land, he is not lord over the fiefs and properties; at best he is a Count, and not the Emperor. "Your Grace has a blessing at the hand of God in the land (the mines); beware, lest He take it away from you, and that your posterity have reason to complain, 'Alas, what a rich and highly favoured territory has our predecessor ruined.'" (Walch; xxi., 463.)

Early in 1546 Luther, distressed at the incessant scandals produced by the mal-administration of the counts of Mansfeld, resolved on going back to his native town to put a stop to the disturbances. Setting out with Dr. Jonas, he arrived as far as Halle, where the Saale was so swollen that they could not cross. Having at length passed the river, they were accompanied by a mounted escort, and brought into Eisleben, where Luther at once proceeded with his work of pacification. He had, however, acquired the seeds of disease during his delay at the river, and this began rapidly to assume more virulence. Undaunted, as usual, by any difficulties, he forgot his bodily weakness, and was favoured with success in a work in which little success was probable, for he reconciled the whole of the counts. His next object was to put their sincerity to the test, by stipulating that they should duly provide for the spiritual and temporal education of their subjects, extorting from them a promise that they would furnish the emoluments of the pastors and schoolmasters at Mansfeld, Eisleben, &c., as well as for all the persons dependent on the several churches; further, that they would found a seminary, or gymnasium, at Eisleben, for the education of such as desired to pursue knowledge in its higher branches, but especially in connection with the ministry. This document Luther drew up in due form, and when completed, obtained the signature of the now pacified counts, with the promise of the 50th *Centner* of all the refined copper to be raised for ever from the Mansfeld mines to defray the expenses.

Having accomplished so noble a task, and brought good out of evil, Luther's bodily frame rapidly underwent dissolution, for he never again rose from the bed where he was lying opposite the St. Andreaskirch, in Eisleben. Overpowered by weakness, he rapidly sank, and probably—a circumstance which cannot be omitted here—the last paper he ever held in his hand, and the final transaction of his eventful life, was this interesting mining document. Two days more and his warrior spirit had sped his flight to a brighter world. We may, therefore, regard Luther not only as the great luminary of the dark ages, to whom we may ascribe much of the grandeur and moral pre-eminence of Britain, but with equal truth affirm that his dying act of pacification saved the Mansfeld mines from ruin, and was in great measure the origin of their present prosperity. During the course of the year the counts abstained from their tyranny, and Albrecht, in taking possession of twenty *Erbfeuer*, paid the smelting-masters 200 florins each. (Krumhaar, *Die Graffschaft Mansfeld*, &c., p. 264.)

In 1559, however, new troubles disordered the community on account of the reckless extravagance of the counts, through which the miners, unable for a long time to obtain their pay, suffered the greatest need. At length, on the 22nd April, 1557, they struck, and, abandoning their work, demanded immediate payment; they even threatened with pain of death any miners who should still work, but by good understanding affairs were brought about peaceably. In 1559, Spangenberg (*Mansfeld'sche Chronik*, p. 479) says, that upwards of 100 miners had left their work and gone off to the war in Detmarsch (Holstein).

In 1562 the counts of Mansfeld made some regulations regarding the smelting works and copper and coal mines. In 1567 a council was held to decide how the mines could be best conducted, in order to bring in revenue to the State and remunerate the owners. Not long afterwards (1572) the counts concluded a contract for ten years with some persons conversant with such matters, who promised to manage the mines so as to make them render better returns. The capital had been for a long time held by a Nuremberg company, who employed at one time as many as 2,000 men—(Von Hagen, *Op. cit.*, p. 261.); when, in 1618, four-fifths were handed over to the Town Council of Leipzig for ten years.—(Rohr. *Op. cit.*, page 707.)

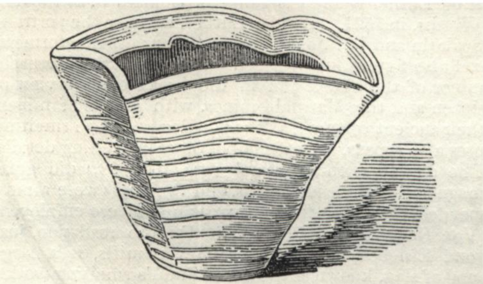
To the antiquarian miner let the writer strongly recommend a short visit to Luther's natal house, containing, among other objects of highest interest, the portraits of many remarkable historical personages of the sixteenth century, besides the various mining celebrities. One quaint panel, attributed to Albert Dürer, has a double signification, probably as a precaution. It represents Nebuchadnezzar, with his crowded court, gazing at the three Hebrew youths in the fiery furnace; but no less gives us the portrait of Luther before the Emperor Charles V. at the diet of Worms, in 1521. Besides Luther, we have the portraits of Spalatin and Dr. Jonas, and numerous other reformers. Tezel also figures in the court. On the left is Stossnach, a miner of the times, and in the background a view of Eisleben and the Mansfeld mines, with groups of miners in their ancient costume, at the windlasses. The smelting houses also appear, with numerous other interesting details.

The disastrous thirty-years' war, (1618–48,) did great damage to the Mansfeld mines, and the works were almost suspended, for at one time only 20 miners were employed. —(Von Hagen, *Op. cit.*, p. 261.) On the road-side, just beyond Eisleben, and close to the windmills, is a large mound of slag, known as the site of Stahl's smelting works, destroyed in 1631, but not a trace of the building remains. A similar mound of slag exists on the opposite side of the brook, the works having been simultaneously devastated. From 1636 to 1639, the soldiers quartered themselves six or seven times in the ruins of Stahl's works, where they demanded bread, beer, and provisions to be sent them from Eisleben, and plundered the neighbourhood at every moment. The men had to fly for their lives, and so great was the spirit of animosity, that every vestige of industry was levelled to the ground all round, so that, as everything had to be recommenced, we may view this as an epoch in the history of the mines.

Rohr, writing in 1736, states that in his time there were already 20 shafts at work in the Mansfeld mines, producing about 80 *Fuder* (214 tons) of ore weekly; the four furnaces yielded annually some 1,200 *Centner* (60 tons) of copper. Argentiferous copper-slate, accompanied by cobalt, (not then treated,) was worked at Wiederstedt, three or four miles from Leimbach. He alludes to the already very ancient slag mounds, near Sangerhausen, to prove that those mines must have been worked for centuries, and says that before the 30 years' war they produced considerable profit, though they had been abandoned. He specifies two localities where copper mines had existed; Botfeld, near Sangerhausen, and Bontendorf, where the copper contained a few *Loth* of silver per *Centner* (probably $\frac{1}{1000}$th).—(*Op. cit.*, p. 696.)

The construction of adit-levels, the formation of more regular shafts with continuous workings, the introduction of the steam-engine, and the improvements in smelting and desilverizing, inaugurate some of the successive advances which bring us down to our own times. The mines again improved after the treaty of Westphalia, in 1670; Karsten, a director, applied 30,000 *Thaler* (£4,500), from the profits as a reserve fund; in the following year several capitalists invested their money in the undertaking. We learn that in 1723 three-tenths of the royalty went to the count, and seven-tenths to the Town Council of Leipzig.—(Von Hagen, p. 261.) Meanwhile the Counts of Mansfeld died out, and the land fell under the victorious arms of Napoleon I., who gave it to Jerome, the new King of Westphalia, a country much larger than the present Prussian province of the name. In 1814, Mansfeld, with a large portion of Saxony, was ceded to Prussia, since which time the Saxon weights and measures have given place to those of Prussia. The mines were administered in six parts, each divided into 128 shares (*Kuxe*) held by private persons. Each smelting establishment yielded its own dividends, but as this was found to be very complicated, they were consolidated under one general superintendence in 1851; since then the dividends of the 768 shares have been equalized.

In ancient times small pits were sunk, and the moment water accumulated to any amount, so as to render pumping difficult, a fresh one was begun close by, often only a few yards off, somewhat on the principle of bell-pits. To say nothing of the experience of such a rude way of mining, much ore was lost. All the ground near the outcrop was thus worked, or rather destroyed, by the ancients, though, fortunately, they only proceeded to a very inconsiderable depth, leaving the best parts of the basin untouched. Since the introduction of gunpowder this antiquated system has been entirely superseded; the drainage of the Eisleben basin has been effected by 17 adit-levels, nine of which are no longer employed, owing to the ground having been worked away. They are by no means all connected together, but terminate according to the requirements of the mine at the nearest water-course.



Scale ½.
EARTHEN POT FOUND IN A VERY ANCIENT PIT NEAR HELBRA.

The relative depth of the levels, invariably reckoned from a guage mark on the door-post of the turnpike at Kloster Mansfeld, is here given in Prussian feet:—

ABANDONED ADIT LEVELS.

			Prussian feet below guage.	
1.	Gute Hoffnung adit level	...	20·31	
2.	Hundkopf "	...	44·65	(entrance.)
3.	Johann Friedrich "	...	49·04	"
4.	Hohheit "	...	50·59	"
5.	Jacob Adolf "	...	52·69	"
6.	Faulensee "	...	56·64	"
7.	Wiederstedt "	...	56·64	"
8.	Todthügel "	...	61·83	"
9.	Langenthal "	...	80·79	"
10.	Naundorf "	...	82·81 84·63	 "

PRESENT ADIT LEVELS.

			Prussian feet below guage.
1.	Jacob adit level	...	48·46 49·17 entrance.
2.	Glückauf "	...	53·37 59·90 entrance.
3.	Froschmühlen "	...	70·17 74·71 entrance.
4.	Zabenstedt "	...	73·97 75·62 entrance.
5.	Erdeborn "	...	74·71 77·84 entrance.
6.	Schlüssel "	...	85·19 87·32 entrance.
7.	Heinitz "	...	88·40 89·31 entrance.

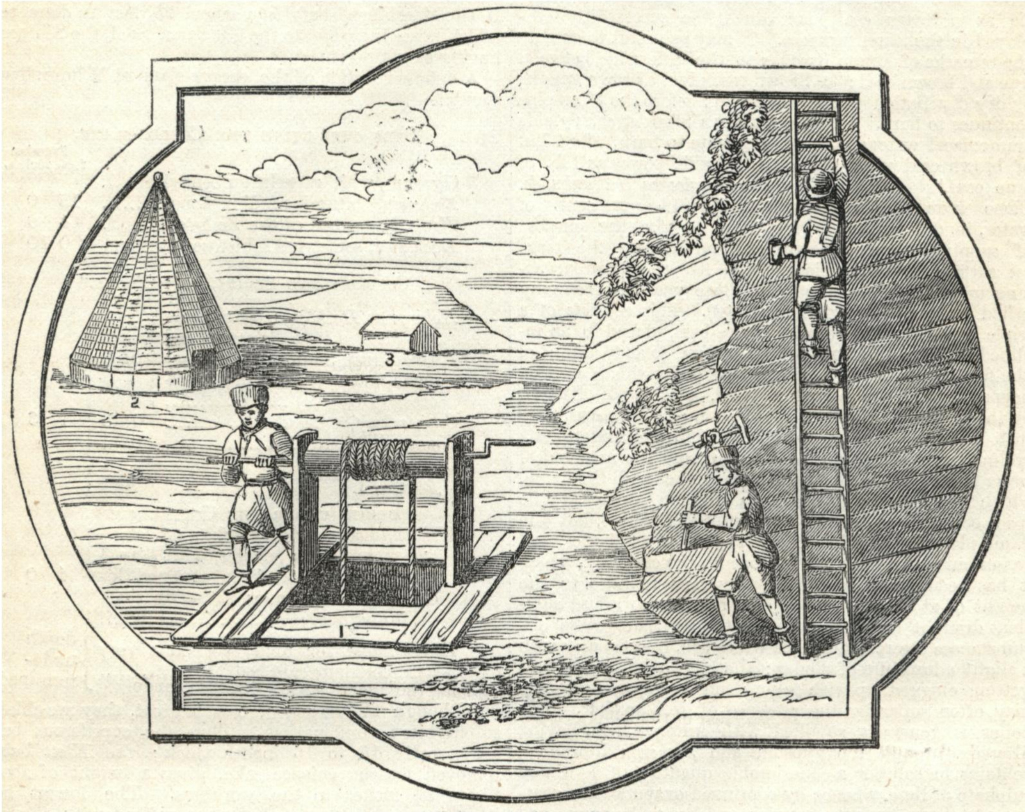
Of the latter list the principal is the Schlüssel Stolln, not yet completed, though 13 miles (10,000 *Lachter*) long. The finished portion extends from Gottesbelohnung to Burgörner, Gerbstedt, and thence to the Schlenze at Friedeburg on the Saale; another part is completed between Wimmelburg and Helbra. The object of this stupendous undertaking—certainly one of the most remarkable engineering works of the kind in existence—is to form a common outlet for the waters of the mines at the Saale. Its dimensions are at least a fathom wide and high above the tramway and planks serving for communication and the conveyance of ores, below which is a deep trough for the water. Part of this adit was made too small, and the extent of the workings necessitating a speedy improvement, it was enlarged at great expense, with no small amount of difficulty, as the water already flowed through it.

In order to construct the levels, shafts were sunk at short distances, and the rock brought up to the surface directly, the adits follow the copper slate at given depths, being generally so contrived that the upper two-thirds lie in the slate, and the remainder in the *Liegendes*, in order that the water may neither incommode the miners nor flood the ore in the direction of the dip. The fall given to the water is insignificant.

Of about 40 shafts, employed for the use of the miners and extraction of the ore, the majority are convenient and spacious; they are rectangular, and divided into three parts, one for the ladders and pumps, the others for the waggons which are placed on platforms, gliding up and down in guides at either side. Since both exterior and interior communication is effected by tramways, the platforms are supplied with rails, the waggons being kept in their place by an iron bar at each end. The frame is invariably prevented from falling to the bottom in case the chain breaks midway by a spring connected with two levers. If an accident occur, and the frame be freed from tension from above, the spring is instantly liberated from its collar and the arms gripe the sides of the guide.

At the commencement a simple windlass (*Haspel*) is set up, worked by two men who raise the ore in "kibbles" (*Kübel*), large barrel-shaped buckets attached to a rope; it is only when the shafts are properly arranged, and the depth much greater, that a horse whim (*Göbel*) is erected. This is a conical building, 60 or 80 feet high; the masonry only reaching a couple of feet above the ground, serves as an abutment for the rafters of a roof, covered with pieces of wood in the shape of tiles. In the centre is a vertical axis, resting on the ground, and passing through the apex, this is furnished above with a drum for winding the wire-rope, and below with two arms for the horses. *Göbel* may be seen among other places at Martin, Wassermann, Erdmann, and Hornickel shafts; the *Haspel* is never long in use at one place. An ancient painting in St. Andreas Kirch, in Eisleben, of which an engraving is given in the next page, represents both these mechanical contrivances which have been used here for centuries precisely the same as they are now.

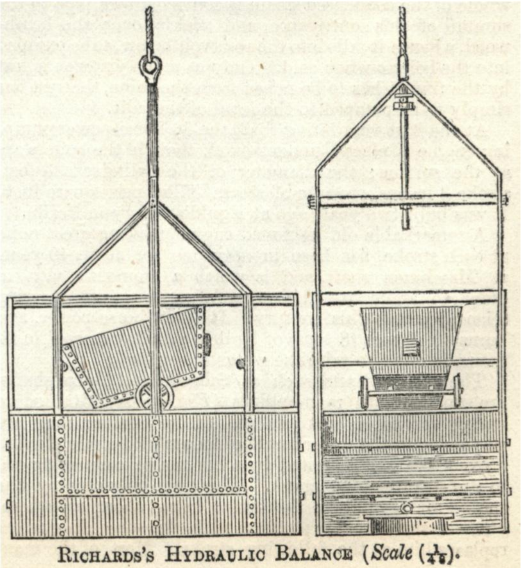
In deeper shafts the motive power in raising the ore is steam or water; the machinery is of German manufacture. At the Schmidt-shaft the raising engine (*Fördermaschine*) is 7 horse-power, with 6-foot stroke; it works 8 hours daily, consuming 7 *Tonnen* (19 cwt.) of brown coal, and also serves alternately to work the pumps and man-engine. At the 80th ventilating shaft, (*Lichtloch*) is a pair of oscillating engines, working with high pressure steam of 42 lbs. to the square inch. The 81st ventilating shaft is provided with a 16 horse-power high-pressure beam-engine, with 3-foot stroke and 14-inch cylinder, working with 42 lbs. pressure to the square inch; it was manufactured at the company's own foundry at Saigerhütte Hettstädt, and erected a couple of years ago. It is only used for 8 hours every other day. The wire rope is passed round a double drum, one part of which winds up as the other unwinds; a peculiarity in the arrangement is that the drum is placed diagonally at an angle of 45° from the floor to the beams above; it is connected with the engine by cogwheels. The quantity of water in the higher levels is considerable; Herr Richards, the inspector of the machinery, has lately devised a very beautiful and simple contrivance to supersede the use of steam, but which I have not noticed in any other mines, though, from its great economy, it deserves attention; this he calls a hydraulic balance (*Wasser-balance*). It consists of a pair of rectangular boxes, formed of thin boiler-plate, firmly bolted and water-tight, 6 feet by 4, and 2½ feet deep; they are kept in shape by 4 longitudinal and 4 latitudinal bars ¼ of an inch in diameter. They are suspended by a light iron frame, and connected at either end of a wire rope with the drum. To raise the ore the vessel is filled with water by a hose at one of the higher levels or at the surface, as may be; it then sinks by its own weight through the shaft to the lowest level, drawing up the empty case and a waggon of ore attached to the opposite end of the rope. Nothing can be easier than the management of this balance; a man stands by the break, a long wooden lever, and gives the necessary freedom of motion, he can instantly stop the case in its descent by applying the break in a horizontal position, and as easily set it going again by liberating it. From 6 to 7 *Centner* of ore are raised each time in a little hand-waggon placed on a platform over the balance. The water is at once emptied from the case by raising a valve at the bottom. One of these machines may be seen at Müller shaft, Burgörner, another at Carolus shaft, Sangerhausen. The water is supplied at the latter place by a conduit several hundred fathoms long, descending into the valley and re-ascending the hill. After deducting the trifling expenses of the building, balances and drums, the cost of keeping up is inconsiderable, certainly not half-a-crown a day.



Glück auff hinauff!

1. Man at Windlass (*Haspel*). 2. Horse-whim (*Gobel*). 3. Wooden office (*Zechenhaus*).

Of the pumping engines (*Wasserhaltungsmaschine*) the finest is probably that at Schmidt shaft, Helbra, built in 1848, by Luig and Co., at Sterkerade, near Oberhausen. It works by single action, on the Cornish principle, with cataract gear and Harvey's butterfly valves. The pressure of the steam in the 47-inch cylinder is from 15 to 20 *Zoll*



RICHARDS'S HYDRAULIC BALANCE (*Scale* ($\frac{1}{48}$).

pounds per square inch; stroke 9 feet in cylinder, 7 feet in shaft. The boilers are cylindrical and consume 30 *Tonnen* (83¼ cwt.) of Emsloh brown coal during the 8 hours in which it is at work. As is well known, brown coal does not give the same amount of caloric as ordinary coal, nor can it be successfully employed in the usual furnaces. It may be useful to sum up the remarks of Bruno Kerl as to the difference between true and brown coal:—"Brown coal gives a brown streak; by dry distillation yields acetic acid; before the blow-pipe continues to burn. True coal gives a black streak; yields ammoniacal water; does not continue to burn. 2·86 lbs. of brown coal yield the same calorific power as 1 lb. of true coal." (*Handbuch der metallurgischen Hüttunkunde.* Since brown coal contains about 14 per cent. of water, and requires a great draught for the purpose of supplying a steady current, and expose the largest surface to the action of the flame, a peculiar arrangement has been adopted of late years in Germany called "step-grates" (*Treppen Röst*). This consists of a triple series of 12 to 15 narrow fire-bars, placed in an inclined plane at the front of the boilers, so as to admit of the freest access of air horizontally; above this is an open hopper on which the coal is piled, so as to fall of itself, by the power of gravity, in proportion as it burns. By such a simple contrivance the combustible undergoes a preliminary roasting and dessication, and the mechanical water is expelled before it comes in contact with the flame, which could not be effected in a common furnace. The space occupied by the fire is about 4 feet square, but the flame plays on the whole lower surface of the boiler, and passes out at the back, and thence up the chimney, which it has been found practically necessary to raise to the height of at least 80 or 100 feet, in order to afford sufficient draught for perfect combustion. Under these circumstances the residuum is a white ash, occasionally with a slight admixture of cinder; there is no fear of the bars getting clogged up with caking substances, though they may often suffer by the presence of iron pyrites. The boiler is generally supplied with water which, having filtered through the gypsum and *Zechstein* limestone, contains in solution a considerable quantity of hydrated sulphate of lime, whence by continued evaporation a coating of gypsum lines the interior, and has to be hammered off from time to time. The condensed steam from the pumping-engine at Schmidt shaft is led to a kind of graduation house (*Gradirhaus*), consisting of a double perpendicular wooden frame, 15 feet high, filled with layers of brushwood, and exposed to the prevailing wind; the whole of the condensed steam is conveyed by a pipe to the summit of this contrivance, and trickles over the brushwood, whence it falls into the reservoir below, to be pumped into the boilers when cold. Only as much water as is lost by the transit has to be raised from the mine, the rest has simply to be pumped to the level of the adit.

At the 81st ventilating shaft the 36 horse-power pumping engine is placed underground, though the boilers are at the surface; the diameter of the cylinder is 3 feet, stroke 9 inches, pressure of steam 35lbs. per square inch. It was built two years ago at Eguld's factory in Berlin.

A remarkable old-fashioned engine, making great noise at each stroke, has been in operation for about 40 years at Maschinen shaft, and is worth a moment's visit in order to appreciate the rapid advance of engineering science during this century. It is 28 horse-power, and burns 60 *Tonnen* (8 tons) of Hollenstedt brown coal in 24 hours, in order to raise the water 7 feet high.

The deeper shafts, such as Schmidt and Bolze shafts, are supplied with man-engines (*Fahr-kunst*) attached to strong vertical beams and guided by chains; they are suspended to the upper angle of an arc of a circle, having a fixed centre, but united by a horizontal connecting-rod to the steam-engine crank. The men only employ the engine for ascending; the stroke being about a fathom, one man stands on the platform while the succeeding miner replaces him at the following stroke. Most of the man-engines are double, two platforms being simultaneously set in motion in contrary directions, the one ascending while the other descends.

Besides the numerous steam and water-engines, powerful underground water-wheels are sometimes employed. In the Maschinen shaft is a wheel 25 feet in diameter, which raises the water to the Glück auf level, the Schlüssel having as yet no outlet.

A detailed section of the copper-slate at Wimmelburg shows:—

BEDS OVER-LYING THE COPPER-SLATE.

	Prussian feet.	inches.
Gypsum, with superincumbent strata ...		
Zechstein,* bituminous limestone	15	0
Faule, lower bed of the *Zechstein*.........	4	0
Dachklotz, somewhat schistose limestone	0	10

COPPER-SLATE SERIES, OR "FLÖTZ."

	ft.	in.		
Noberge or *Dachberge* (sometimes sub-divided into *Schwartz* and *Grau-berge*), bituminous limestone, and region of "roof-ores" (*Dacherze*)	0	8	1	3
Schieferkopf, "head"...............	0	3		
Kammschale	0	1		
Grobe and *feine* ... *Lette*......................	0	3		

SERIES UNDER THE COPPER-SLATE.

Weissliegendes, very dense white sandstone free from quartz pebbles, with ½ to ¾ inch of "sand-ores" in confined localities, chiefly under Erdmann shaft (Wimmelburg)	4	0
Rothliegendes, the upper portion a very hard conglomerate bed	depth undetermined.	

Although the variety of ores is great, they are chiefly sulphuretted combinations. Thus the cupriferous beds are locally 15 to 16 inches thick; the *Klotz* being removed for convenience sake, gives a height of about 21 to 24 inches to the workings. The lowest bed is soft or semi-indurated; when rubbed with a piece of iron it presents a smooth polished surface; by the fatness of the brown streak thus exhibited the miners judge of its richness in copper ore, as the most careful ocular examination would often fail to show any metalliferous particles; it rather assumes the appearance of fat coal, and may be cut with a knife. This earthy substance, called *Schramm*, is very inconstant and often absent; in other places it is seen above or in the *Lette*, the most important member of the copper-slate formation. Owing to its assuming two distinct physical forms, the *Lette* is divided into fine and coarse (*feine* and *grobe Lette*), the former, or lower variety, is a blackish slaty rock, pervaded parallel to the planes of stratification with an infinite number of minute particles of copper ore, either bright yellow copper pyrites, gray or purple copper, copper indigo, or cupriferous iron pyrites. In section, even when freshly cut, these are often only rendered visible in the rays of the sun, or by the use of a lens, but by a blow on the edge the stone is perceived to have a foliated structure, each portion as it is detached from the rest is dotted over with minute metalliferous faces. The *grobe Lette* differs from the former simply in that the particles of ore are larger, more concentrated, and easily distinguished by the naked eye. It often contains several thin plates of "horse flesh ore" (*Buntkupfererz*) and vitreous copper (*Kupferglanz*), ⅛th to ¼ inch in thickness between the planes of stratification, also thinner streaks of copper pyrites (*Kupferkies*).

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* *Zeche* is a portion of a mine; a *Zechenhaus* is the little building where the miners meet every morning to pray, and the captains call over the roll before they descend to their work. These erections being generally situated on the gypsum, or limestone, have given origin to the name *Zechstein*.

The *Kammschale* is immediately distinguished by the delicate white hair-like streaks which alternate with the black ground; these markings are not continuous, but about an inch long, with a small interval between each; they are chiefly composed of sulphur, which I regard as due to the chemical decomposition of some sulphide originally contained in it, for a preponderance of these streaks is the best sign that it is too poor in copper to be smelted; other indications of its worthlessness, are its brown colour and earthy, dull-gray streak when rubbed. The *Schieferkopf* is a more uniform slaty bed, without the delicate metalliferous particles of the *Lette* or the streakings of the *Kammschale;* it frequently contains ore between its layers. The presence of ore in the *Dachberge* is in the highest degree uncertain, but this has its advantages—in that, when found, it generally consists of concentrated masses of purple copper ore, as large as a bean, in the midst of very bituminous limestone, which breaks off in masses, easily separating from the bed above, and serving as a flux. When the rock has a brownish tint it is distinguished as *Grauberge*, and when black, as *Schwartzberge*. These are pretty nearly synonymous, except that by the word *Dachberge* it is supposed to cover the ores as a roof; the ores obtained from this roof are termed *Dacherze*. The only distinction observable between the *Dachklotz* and superincumbent *Dach* or *Faule* is, that the *Klotz* has a very undulating though smooth surface, and forms the transition to the beds above. Being in most cases continuous, each bed can be blasted separately; it is only on reaching the *Zechstein* limestone that we find 12 to 20 feet of more compact bituminous rock.

(*To be continued.*)

EXAMINATION PAPERS, 1861.

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in April and May last:—

ARITHMETIC.

THREE HOURS ALLOWED.

1. Find by Practice, the cost of 365½ yds. at 13s. 5¾d. a yard.

2. What is the rent of a farm which contains 315 ac. 3 ro. 7 per. at £1 16s. 8d. an acre?

3. A pound of mould candles costs 8d., and contains 6 candles; a pound of dips costs 6½d., and contains 10 candles, 1 mould will burn as long as 2 dips, viz., 6 hours, which are the more economical?

4. A owes B for 27 yds. 3 qrs. 3 nls. of cloth at £1 3s. 6d. per yd., and B owes A for 61 English ells 3 qrs. 2 nls. of silk at 7s. per English ell. What is the balance of the account, and in whose favour?

5. The gas consumed by one burner for 56 days costs £2 7s. 6½d. What will the gas of another burner cost for 40 days which consumes only $\frac{23}{40}$ of the former?

6. A workman was hired for 40 days on condition of receiving 1s. 8d. for each day he worked, and paying 10d. for his board each day he was not employed. He received £2 1s. 8d. Find the number of days he was employed.

7. If 24·25 francs be equivalent to £1, express £24 10s. in francs and 97 francs in English money.

8 When a rent has been reduced ⅕th, a rate of 16d. in the pound amounts to £18. What is the rent?

9. If A can do a certain work in 2⅔ days, and B can do ⅗ of it in 4½ days, in what time can it be done by both working together?

10. From London to Brighton is 50½ miles. In what time will a train perform the journey at the rate of 990 yds. per minute, allowing $\frac{5}{24}$ of an hour for stoppages?

11. If 24 men in 2½ days of 12½ hours, dig a trench 139·75 yards long, 4½ yards wide, and 2½ yards deep, what length of trench will 90 men dig in 4⅕ days of 9⅔ hours; the trench being 4⅞ yards wide and 3⅕ yards deep?

12. A candidate must get ⅓ of the whole marks to pass an examination. He answers half the questions, but to ⅚ of his answers he gets on an average only ⅗ of the marks, and thus has 25 too few to pass. How many does he get altogether?

13. The floor of a room is 25 feet 7 inches by 15 feet 5 inches, and the height is 7 feet 4 inches; what will be the expense of papering the walls at 1d. a square yard, and of whitewashing the ceiling at 2d. a square yard; and how many persons may sleep in it, allowing 300 cubic feet for each?

14. A person pays income-tax for 9 months in the year, at the rate of 5d. in the £, and for the remainder of the year at 7d. in the £; what should be his gross annual income to leave him a surplus of £2,000?

15. A person invests £3,412 10s. in the Three per Cents. at 91; he sells out £2,500 stock when they have risen to 93½, and the remainder when they have fallen to 85. How much does he gain or lose by the transaction? If he invests the produce at 4½ per cent. stock par, what is the difference in his income?

16. Butchers' meat sells at one time for 10s. 7½d. per stone of 14 lbs.; and at another time for 4s. 5d. per stone; what is the rate per cent. of decrease?

17. Find the difference between the compound interest on £840 for four years at 5 per cent., and for five years at 4 per cent., payable in each case half-yearly.

18. What is the gain per cent. in buying goods at £27 per ton with four months' credit, and selling them for ready money one month after purchase at £29 per ton?

19. If a cistern 12 feet long, 6 feet wide, and 2½ feet deep, is filled by 3 equal pipes in two hours, how long would it take to fill a cistern containing a thousand gallons by two such pipes, supposing the weight of a gallon of water to be 10 lbs., and that of a cubic inch of water to be 250·5 grains?

20. In a match of cricket, a side of 11 made a certain number of runs; one obtained ⅛th of the number, each of two others $\frac{1}{10}$th, and each of three others $\frac{1}{20}$; the rest made up between them 126 the remainder of the score, and four of these last scored each 5 times as many as the other. What was the whole number of runs, and the score of each player

BOOK-KEEPING BY DOUBLE ENTRY.

THREE HOURS ALLOWED.

1. In what consists the distinction between double and single entry?

2. Are all errors to which a book-keeper is liable preventable or discoverable, if his books be kept by double entry?

NOTE.—State reasons for the answer to this question.

3. State the use of the Journal.

4. What is the use of the Ledger?

5. Write out in proper technical form and language the Journal and Ledger entries of the following transactions:—

Bought 200 tons of pig iron from the Carron Company for	£850	
Accepted Carron Company's draft for .		£850
Sold to W. Jones, 100 tons of pig iron for . . .	£500	
Received of W. Jones his acceptance for .	400	
And Cash	100	

6. What is the nature of the items which enter into the composition of a profit and loss account, and what does its result exhibit?

7. What should a Balance Sheet exhibit?

8. Journalise and post in proper technical form and language the following imaginary facts and transactions,

and draw out from the Ledger a trial balance, a balance sheet, and a profit and loss account.

On the 1st January, 1861, Charles Stuart ascertained that the state of his affairs was as follows:—

ASSETS.	
Pig iron, 400 tons at £4 per ton	£1,600
Balance of cash in hand	1,400
O. Cromwell's acceptance due 10th January	500
DEBTS.	
C. Stuart's acceptance due 25th Jan.	570

Transactions subsequently to 1st Jan. 1861.

1861.				
Jan. 4.	Purchased of Carron Company 200 tons of pig iron	900		
„ 5.	Sold to J. Locke, 300 tons pig iron	1,400		
„	Received of J. Locke, his acceptance due 8th March	1,000		
„	Received cash of J. Locke	200		
„ 10.	Cash paid, freight and insurance, on 200 tons of pig iron	45		
„ 11.	O. Cromwell's acceptance, due 10th inst., returned dishonoured	500		
„	Cash paid Notarial charges thereon	1	10	0
„ 12.	Sold to J. Locke, 200 tons pig-iron	1,000	0	0
Jan. 15.	Paid Cash to the Carron Company	900	0	0
„ 17.	Discounted J. Locke's acceptance for £1,000.			
„	Received Cash proceeds of Bill	992	10	0
„	Discount charged thereon	7	10	0
„ 18.	Received of J. Locke his accepance due 4th April	800	0	0
„ 21.	Purchased of C. J. Mare and Co., 2,000 tons iron rails @ £5 10s.	11,000	0	0
„ 23.	Consigned to Pernambuco, on my own account and risk, to the care of Ewart and Co., of that place, 1,000 tons iron rails, at cost price of £5 10s. per ton	5,500	0	0
„	Received of Vernon and Co., of London, by way of advance on the above shipment, their acceptance at four months' date	3,000	0	0
„ 24.	Accepted C. J. Mare and Co.'s draft on me at 3 months' date	6,000	0	0
„	Paid cash to C. J. Mare and Co., on account	2,500	0	0
„	Cash paid, freight and charges on iron rails consigned to Pernambuco	750	0	0
„ 25.	Cash paid, my acceptance due this day	570	0	0
„	Cash paid J. Mackenzie on my private account.	160	0	0
„	Sold to G. Stephenson, 200 tons iron rails, @ £6 per ton	1,200	0	0
„	Received of G. Stephenson, his acceptance due 28th March	1,000	0	0
„ 26.	Sold to J. Locke, 600 tons iron rails @ £6 per ton	3,600	0	0
„ 28.	Received cash of J. Locke, on account.	2,800	0	0
„	Cash received from O. Cromwell on account of his acceptance due 10th instant, returned dishonoured	200	0	0
„ 31.	Cash paid my clerk 1 months' salary to date	25	0	0
„	Interest accrued to this date, viz., one month on capital account	11	5	0
	Stock on hand 31st January, viz.,			
	Pig-iron at £4	400	0	0
	Iron rails at £5 10s.	1,100	0	0
	Amounts due and unpaid 31st January, viz. :—			
	To Wm. Johnson, 1 mos'. rent of office and warehouse	13	6	8
	To J. Howard, for stationery supplied	6	10	0

Nota Bene.—Candidates who reply to No. 8 need not reply No. 5. but *satisfactory answering* in No. 8 will be deemed an indispensable condition to a high degree of excellence.

ALGEBRA.

THREE HOURS ALLOWED.

A

1. Find the value of $6x^4 - 5x^3 - 4x^2 + x - 96$ when $x = \frac{3}{2}$, and of $6x^4 - 5ax^3 - 4a^2x^2 + a^3x - 96a^4$ when $x = \frac{3a}{2}$.

2. Multiply $a^2 + b^2 + c^2 - ab - ac - bc$ by $a + b + c$.

3. Divide $x^7 - 4x^5 - x^2 + 4$ by $x^2 + x - 2$.

4. If $ax^5 + bx^4 + cx^3 + dx^2 + ex + f = X$, and $a + c + e = b + d + f$, prove that X will divide out by $x + 1$ without leaving any remainder.

5. Find the greatest common measure of $x^3 + a^3$, and $x^2 - 2ax - 3a^2$; and reduce the fraction $\frac{1 + x^3}{+ 2x^2 + x^3}$ to its lowest terms.

6. Solve the equations

$$\frac{3x - 8}{5} + \frac{7x - 37}{8} = \frac{x + 1}{4} + 7.$$

$$\left.\begin{aligned} x + 27 + 3z &= 11 \\ y + 22 + 3x &= 17 \\ z + 22 + 3y &= 8 \end{aligned}\right\}$$

7. Suppose $\left.\begin{aligned} 3x + 5y + 9z &= 18 \\ 4x + 7y + 13z &= 70 \\ 5x + 8y + 14z &= c \end{aligned}\right\}$

Ascertain if it is possible to satisfy all these equations at once for *every* value of c, and if not, what c must be when the three equations do admit of being satisfied by the same values of x, y, z.

8. If $\frac{a}{b} = \frac{c}{d}$ prove that $\frac{a + b}{a - b} = \frac{c + d}{c - d}$

B.

9. Find the sum of an arithmetical series whose first term is 110, common difference 13, and the number of terms 1,000.

10. Find the square root of
$1 - 6x + 15x^2 - 20x^3 + 15x^4 - 6x^5 + x^6$.

11. Solve the equations $\left.\begin{aligned} x^2 + xy + y^2 &= 49 \\ 2x - y &= 7 \end{aligned}\right\} (1.)$

$$\left.\begin{aligned} x^2 + xy &= a^2 \\ y^2 + xy &= b^2 \end{aligned}\right\} (2.)$$

12. A waterman can row five miles with the tide in his favour in three-quarters of an hour, but requires an hour and a half to row back as far against the tide, when it is only half as strong as before, how long would he take to perform the same distance if there were no tide at all?

13. Prove that the sum of the squares of two unequal numbers is always greater than the double of their product, and the sum of the squares of three unequal numbers always greater than the sum of the three products that may be obtained by combining them two and two together.

GEOMETRY.

THREE HOURS ALLOWED.

1. The angles at the base of an isosceles triangle are equal to one another; and if the equal sides be produced, the angles on the other side of the base shall be equal.

2. Make a triangle of which the sides shall be equal to three given straight lines.

What condition must exist between the three lines? Show that the construction fails if this be not observed.

3. To a given straight line apply a parallelogram which shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

4. Divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square of the other part.

5. A segment of a circle being given, describe the circle of which it is a segment.

6. If two straight lines cut one another within a circle, one of them passing through the centre, prove that the rectangle contained by the segments of one of them is equal to the rectangle contained by the segments of the other.

7. Describe an isosceles triangle, having each of the angles at the base double of the third angle.

What is the ratio of the radii of the two circles in the figure?

8. Triangles and parallelograms which have the same altitude are to one another as their bases.

9. If four straight lines be proportionals, the similar rectilinear figures similarly described upon them shall be proportionals.

10. If a straight line stand at right angles to each of two straight lines in the point of their intersection, it shall be also at right angles to the plane which passes through them, *i.e.* to the plane in which they are.

11. If a solid angle be contained by three plane angles, any two of them shall be greater than the third.

12. Circles are to one another as the squares of their diameters.

Problems.

1. Find a point in the base of a triangle, such that if perpendiculars be drawn from it upon the sides their sum shall be equal to a given line.

2. Two chords of a circle are drawn, so as to touch a concentric circle, the trapezium being completed, show (by means of the 3rd Book only, without assuming the properties of similar triangles) that the diagonals are bisected by the line joining the middle points of the chords.

3. If a circle roll within another of twice its size, any point in its circumference will trace out a straight line.

4. Describe a circle which shall touch a straight line at a given point, and bisect the circumference of a given circle.

5. Trisect a parallelogram by straight lines drawn from one of its angular points.

6. In a given circle inscribe three equal circles, touching each other, and the given circle.

7. Draw a line from the vertex of a triangle to the base, which shall be a mean proportional between the whole base and one segment.

8. Through a given point draw a circle touching two given circles.

9. The six planes bisecting the dihedral angles of a triangular pyramid, meet in a point.

MENSURATION.

THREE HOURS ALLOWED.

1. What is the arithmetical measure of (1) a line, (2) an area, (3) a solid, and (4) an angle?

2. Find the number of feet and inches in the two rectangular areas which are respectively :—

(A) 45 feet 7 inches by 37 feet 5 inches,
(B) 10 feet 5⅔ inches by 7 feet 6⅓ inches,

by the method of "cross multiplication;" and verify your results by some other method.

3. If the sides of an isosceles triangle be given, what will be the angle between them—

(A) when the area of the triangle is the greatest possible?
(B) when it is half this size?

4. Find the area of the field ABCD, when the diagonal AC = 650 links, the perpendicular from B upon AC = 304, CD = 450, and DA = 800?

5. What will be the expense of covering a roof at £2 3s. 4d. per square, the length of the roof being 39 feet 6 inches, and the girth 26 feet 5 inches?

6. Required the expense of glazing an oval window 3 feet 6 inches by 2 feet 7 inches, at 2s. 1½d. per square foot.

7. Find the whole quantity of timber contained in four blocks, each of which is 16 ft. long, and their other dimensions are respectively 4 ft. 7 in. by 3 ft. 4 in., 3 ft. 5 in. by 2 ft. 8 in., 3 ft. 4 in. by 3 ft. 5 in., and 2 ft. 8 in. by 4 ft. 7 in.

8. Indicate some method of finding the ratio which the circumference of a circle bears to its diameter.

9. From a point without an enclosed circular area two lines are drawn, one of which touches the circle and the other is the shortest which can be drawn to reach the circle; the former is 8 chains, and the latter 4 chains in length; find the diameter and area of the enclosure.

10. Compare the values of two coins of the same metal:—

(A) when their diameters are in the ratio of 2 to 3,
(B) when their surfaces are in the ratio of 2 to 3, supposing them to be of the same thickness in each case.
(C) when they are *similar*, and their linear dimensions are as 2 to 3.

11. How many medals can be made from a cubic inch of metal, each medal being 1-10th of an inch thick and 3-4ths of an inch in diameter? What will be the weight of each medal if its specific gravity be 8·8?

12. If the surface of a cone when unwrapped becomes a semicircle, what is the angle of the cone?

13. Find the solid content of the segment of a sphere of which the height is 9 inches and the radius of the base 10 inches?

14. A cone and cylinder of the same altitude and on the same base contain, in their curved surfaces, 120 square inches each; find the area of the base.

15. Find the weight of hay in a stack of the following dimensions:—The circumference at the base is 40 feet, at the eaves 53 feet 4 inches; the height of the eaves is 14 feet, and the height of the top 22 feet; the upper part is conical, and the lower is the frustum of a cone. Each cubic yard is supposed to weigh 200 lbs.

16. If a cubical vessel be filled with water, and then turned about one of its corners in such a way that its four sides are always equally inclined towards the horizon, in what position will it be when five-sixths of the water is poured out?

CONIC SECTIONS.

THREE HOURS ALLOWED.

Section I.—Geometrical Conics.

1. Define conic section, focus, directrix, vertex, centre, diameter, tangent; and prove that the tangent of a hyperbola bisects the angle between the focal distances.

2. Prove that the subtangent of the parabola is equal to twice the abscissa; (NT = 2. AN); and that this theorem is true whatever is the diameter, if NP is the corresponding ordinate.

3. If the tangent to an ellipse at the point P meets the directrix in the point Q, and if S is the focus corresponding to the directrix on which Q is, then SQ is perpendicular to SP. Hence, also, prove that the tangents to an

ellipse at the extremities of a focal chord meet in the directrix.

4. A is the vertex of a parabola, S is the focus, P is a point on the curve, and PN is the ordinate of the principal axis; show that $PN^2 = 4 AS. AN$; and that the perpendicular from S on a tangent intersects that tangent in the tangent to the curve at the point A.

5. What are asymptotes to a hyperbola? Show that the area of the triangle contained between the asymptotes and a tangent to the curve is constant.

6. Define conjugate axes of an ellipse. CP and CD are conjugate semi-axes, and PM and DN are the corresponding ordinates; show that

$$(1.)\ CM^2 + CN^2 = CA^2$$
$$(2.)\ CP^2 + CD^2 = CA^2 + CB^2$$

7. The parameter of any diameter of a parabola is equal to four times the focal distance.

8. Explain all the methods you know for describing by continuous motion (1) a parabola; (2) an ellipse. Which is best adapted for a mechanical instrument?

9. If P is a point on a hyperbola, and CD is conjugate to CP, and S and H are the foci, then $SP \times HP = CD^2$.

10. Prove that the section of a cone, made by a plane which cuts both slant sides, is an ellipse; and determine its principal axis, directrix, and focus in terms of the given elements of the cone and the plane of section.

11. Determine in reference to a parabola, the position of the plane in which it is projected into a circle; and hereby prove that the "area of the parabola" is two-thirds of the circumscribed rectangle.

SECTION II.—ALGEBRAICAL CONICS.

12. Find the equation to a straight line passing through the point of intersection of the two lines

$$a x + by + c = 0$$
$$a'x + b'y + c' = 0,$$

and equally inclined to the co-ordinate axes. Is the result the same whatever be the angle between the co-ordinate axes?

13. Prove that the locus of a point, the perpendicular distances of which from two given straight lines are in a given ratio, is also a straight line.

14. Determine the co-ordinates of the points in which the straight line $A x + B y + C = 0$ meets the circle $x^2 + y^2 = r^2$. Hence deduce the conditions that the line should touch the circle, and geometrically interpret the result.

15. Find the equation to the circle passing through the points (1, 2), (2, 3), (− 2, 5), and determine its radius and the co-ordinates of its centre.

16. Find the equation to the normal of a parabola at a given point, and prove that from any point *generally* three normals can be drawn to a parabola.

17. Prove analytically the theorems contained in questions 2, 5, 6, 7, 9, of the preceding section.

18. Examine and trace the lines represented by the following equations.

$$(1.)\ x^2 - y^2 = 0$$
$$(2.)\ y^2 + 2 xy + x^2 + y - 3 x + 1 = 0$$
$$(3.)\ 3 x^2 + 2 xy + 3 y^2 - 16 x + 23 = 0$$

19. Show that the equation of the second degree may, by change of origin and axes, be reduced to the form $Ax^2 + By^2 + F = 0$, if the curves which it represents are central.

(*To be continued.*)

EXHIBITION OF 1862, AND MECHANICS' INSTITUTIONS.

TRAVELLING CLUB.

The Committee of the Basingstoke Mechanics' Institution, with a view to enable the working classes of the town and neighbourhood to provide, by small weekly payments, the means of going to London to visit the Great Exhibition proposed to be held during the summer of 1862, have resolved to establish an "Exhibition Travelling Fund Club" in connection with the Institute, subject to the following rules, viz.:—

1. That the General Committee of the Mechanics' Institute, with such other members as they may appoint, be considered as the committee for organising and carrying out all necessary arrangements of the "Exhibition Travelling Fund."

2. That the full deposit of each member shall not be less than 5s., to be paid by weekly contributions of not less than one penny. Each payment to be entered on the member's "subscription card" at the time paid.

3. That two members of the Committee shall attend at the Mechanics' Institute every Monday evening, from eight to nine o'clock, to receive subscriptions, and give any information required.

4. That the weekly subscriptions shall be considered to commence on Monday, June 3rd, 1861, at the hours stated in Rule 3, and shall terminate on Monday, June 2nd, 1862.

5. Any person becoming a depositor at any time after the first week, shall pay up the arrears then due.

6. Any member leaving the town, or being unable from sickness, or other reasonable cause, to continue his or her deposits, shall be entitled to receive the amount he or she has paid in, subject to a small deduction (to be decided by the Committee) towards the expense of printing and other charges.

7. That none but subscribing members to the "Exhibition Travelling Fund Club" shall be allowed to participate in any special advantages obtained by the Committee from the railway authorities or others for the benefit of such "Travelling Fund Club;" neither shall the tickets issued by the Committee be made available for any other purpose than visiting the proposed Exhibition.

DIVING APPARATUS.

The following is extracted from the *Times*:—

"The experiments with the diving apparatus* on the plan suggested by Mr. White, surgeon, of Finchley, were resumed on Wednesday, the 3rd of July, at Portsmouth Dockyard, in the presence of the officials of the establishment by order of the Commissioners of the Admiralty. Mr. White's invention consists of a cylinder, in lieu of the ordinary diving dress, and of two vulcanized india-rubber tubes in lieu of an air-pump for the supply of air. The tubes are used by Mr. White both with the customary diving dress and helmet when the work to be done lies on the ground, and with the cylinder when the latter is used for cleaning the bottoms of iron ships. The cylinder in use was roughly formed of wood, and hooped with iron. It leaked so much that it could be kept under water no length of time. The cylinder is constructed of sufficient size to contain a man, and with room enough to give play to his shoulders, his arms working free outside through holes in the case fitted with vulcanised india-rubber sleeves. These, however, can be readily dispensed with if the operation to be performed is simply the scraping of the vessel's bottom, a scraper being fitted in front of the cylinder with its handle working from the interior through an india-rubber valve. The top of the cylinder is closed by a cap, in which are glass lights to enable the man to see his work, and which is fastened by india-rubber springs and hooks from the inside. A brass nut screws into the centre of the cylinder cap through which pass two india-rubber tubes for the supply of fresh air and the discharge of the heated air from the cylinder. The supply pipe is fitted with a mouthpiece. By a simple

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*** This apparatus was shown in the Society's last Exhibition of Inventions, and was numbered 96 in the Catalogue.**

contrivance it is fastened over the mouth of the man inside the cylinder, who thus draws each breath directly through the tube from the surface of the water overhead. Each respiration of the man under the ship's bottom can be counted by those in charge of the tube ends by the working of a slight valve at the end of the supply tube, the stoppage of which will at once indicate that something is wrong below. There are other means of safety. Through the two tubes which supply the fresh and discharge the heated air, conversation to any extent may be kept up between the man at work below and those who are in attendance upon him above, by which means he also directs their movement of the cylinder to any portion of the ship's bottom to which his work may require him to go. In the event of any sudden and unforeseen danger, when there is no time to communicate by speech through the tube, the man can cast loose the springs of the cylinder cap, and, throwing it off, rise to the surface of the water in his inflated india-rubber life-jacket. Although the trial was necessarily short, owing to the leakage of the cylinder, it was quite sufficient to prove the soundness of the principle, and its adaptability, at a wonderfully cheap rate, for cleansing the bottoms of iron ships when afloat and without the means of docking."

Home Correspondence.

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LEEDS STUDENTS' UNION.

Sir,—The Leeds Students' Union is a society composed of those persons who have obtained certificates at the Society of Arts' Examinations, in connection with the Leeds Mechanics' Institute, the Young Men's Christian Institute, and the Church Institute, and they are anxious that the attention of the Council of the Society of Arts, and the representatives of Institutions, should be directed to the scheme of Examinations, with a view to its further development.

The candidates who compose this union, while expressing their high appreciation of the plan adopted by the Council of the Society of Arts, and, acknowledging the great value it has been to each of them, believe that by the introduction of one or two new features, the scheme of Examinations may not only be made more useful and important, but more universally popular as a means of promoting the education of the people.

The first suggestion is, that the Council should award, in addition to prizes and certificates, medals, as a higher form of reward. Those who are familiar with the working of the Society's Examinations will be aware that there are many candidates who offer themselves for three or four years in succession, and who manage, by persevering industry, to take a first rank in a variety of subjects. To such persons the obtaining of first-class certificates, when they hold perhaps six or nine, will be of little interest. They will naturally desire that something of still higher value should then be placed before them to strive for and earn. Now, I feel assured that a large number of candidates in this district would regard it as a matter of the deepest moment to the complete success of the Society of Arts scheme of Examinations, if it could present before candidates something that would induce students of evening classes to pursue step by step such a curriculum as would eventually lead them to matriculate at the universities of London or Dublin.

The Society of Arts would then have bridged over, for the industrious and middle classes, all the difficulties at present apparent in the educational appliances of the times, and would have before it for several years to come most efficient machinery, not only for encouraging the cultivation of that knowledge which has reference to the useful arts, but for giving an impetus to the cause of learning in general. The following details are suggested:—

That there should be two classes of medals. A silver medal to be given to those who obtain five first-class certificates in the course of two years; and a gold medal to such as pass with proficiency through a certain number of subjects at one Examination.

The Students' Union would also ask your favourable attention to a suggestion made at the last Conference with regard to situations in the Government dockyards, &c., for those candidates who obtain first prizes, and are following occupations of a mechanical nature. Amongst the first prizemen for several years you will find that mechanics have frequently been found. To such the Council have offered nominations to Government clerkships. In most cases these have been declined, not because the candidates did not want promotion of some kind, but because the occupation of a Government clerk was entirely foreign to their taste and mechanical ability. Had the Council offered a situation in a first-rate engineering establishment of acknowledged repute, or in a Government naval factory, such a post, though hard work had been connected with it, would have proved a much greater boon, and a mathematical prizeman in such a position might render, possibly, eventually, good service both to himself and his country, where encouragement and scope was given to his inventive talent.

I can only say, if you will kindly direct the notice of the Council to these matters, you will confer a great obligation upon the young men of Leeds.

I am, &c.,
C. S. SPENCE,
Hon. Sec. for Working Men's Institute, and Durham University Middle Class Examinations.

Proceedings of Institutions.

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Barnet Institute.—The twelfth annual report for the year 1860-1, congratulates the members on its continued and increasing prosperity. The number of members now on the books is 180. Of these 30 have been elected during the past year. Between October 23rd, and April 10th, 1861, more than 20 lectures were delivered. In two or three instances the travelling expenses were paid, but with the exception of a trifling outlay on this account, the lectures were entirely gratuitous. The lectures have been listened to by large and attentive audiences, and there can be no doubt that their delivery, (apart from the instruction thereby conveyed), has been productive of much good feeling amongst the various classes of persons who were assembled on these occasions in the Town Hall. The Committee are most desirous that classes should be formed in connection with the Institute, for instruction in various branches of education. An arithmetic class has been in operation during the past year. The library contains various useful works, but it cannot be said to be in a satisfactory state, and to render it sufficiently comprehensive would require an amount of funds which the Committee can hardly hope at any time to possess. They therefore earnestly invite the friends of the Institute to favour them, as opportunity may occur, with donations of books. The funds are in a satisfactory condition, the receipts having amounted to £63 0s. 10½d.; and the expenditure £51 5s. 9½d.; leaving a balance in hand of £11 15s. 1d.

Chippenham Literary and Scientific Institution.—The last annual report of this Institution speaks of its continued increase and success. The number of subscribers at present is 29, at an annual subscription of £1, and 60 at 10s., being a small increase on the previous year. The library has received the addition, during the past year, of 150 volumes, and now contains 669 volumes; and the reading-room is well supplied with newspapers and periodicals. The thanks of the Institution are due to the President, G. P. Scrope, Esq., M.P., who kindly forwarded a donation of £5, which the Committee expended in the purchase of Alison's History of Europe, 20 vols., and Napier's Peninsular War, 6 vols. The Institution has been indebted for lectures to the following clergymen and gentlemen :—The Rev. J. Wilkinson, Rector of Broughton Gifford, "On Shakespeare." The Rev. A. Headly, Rector of Hardenhuish, "On the attempted Invasion of England by the Spaniards in 1588." H. A. Merewether, Esq., "On Ancient and Modern Locomotion." M. H. Marsh, Esq., M.P., "On Australia." Capt. Hans Busk, of the Victoria Rifles, delivered a lecture on "Rifles and Rifle Shooting," which, however, was not so numerously attended as the importance of the subject demanded. The statement of accounts shows that the receipts have amounted to £74 16s. 9d., and that there is a balance in the hands of the treasurer of £2 5s. 8d.

To Correspondents.

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Erratum.—In last number of *Journal*, p. 599, col. 2, line 47, for "Westow" read "Wistow;" and p. 600, col. 1, lines 20, 22, and 26, for "mask" read "wash."

PATENT LAW AMENDMENT ACT.

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APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, July 5th*, 1861.]

Dated 25th February, 1861.

479. W. Dray, Farningham, Kent—Imp. in fire places.

Dated 7th June, 1861.

1454. W. A. Sands, New York—Imp. in the construction or manufacture of sails for ships or other vessels.

Dated 17th June, 1861.

456. J. Lewis, 51, High-street, Bloomsbury—Improved machinery for cutting and boring wood and other substances.
1548. T. Routledge, Eynsham Mills, near Oxford—Imp. in the manufacture of paper.
1549. W. Clark, 53, Chancery-lane—Imp. in the manufacture of letters, designs, and other articles of mica variously coloured or metallized. (A com.)
1550. W. Clark, 53, Chancery-lane—Imp. in batteries and in breech-loading ordnance and projectiles for the same. (A com.)

Dated 18th June, 1861.

1554. J. Banks, Salisbury-street, Adelphi—Imp. in electro-magnetic telegraph printing apparatus or marking instruments.
1556. F. Ziffer, Vienna—Certain imp. in carding engines for carding cotton and other fibrous substances.
1564. J. A. Limbert, Woodville-terrace, Gravesend—Imp. in mounting and fitting ships guns and other ordnance.
1566. M. McKay, Birmingham—An imp. or imps. in the manufacture of cements or adhesive solutions for joining or connecting together surfaces or articles of leather, wood, paper, or other similar articles.
1570. J. Dixon, Gallowgate Works, Newcastle-on-Tyne—Imp. in water-closets and cocks used therewith.

Dated 19th June, 1861.

1574. W. Clark, 53, Chancery-lane—Imp. in umbrellas and parasols. (A com.)
1576. P. Schafer and F. Schafer, Golden square—Imp. in travelling bags or cases.
1578. J. Faulding, 340, Euston-road—Imp. in locomotive engines.
1580. J. F. Williams, 10, Queen-square, Middlesex—Imp. in compounds of india-rubber and gutta-percha with other substances.
1582. J. Cullen, North London Railway, Bow—Imp. in preserving wood and iron.

Dated 20th June, 1861.

1584. J. Fletcher and J. W. Fuller, Salford, Lancashire—Certain imp. in machines for planing, boring, and turning.
1588. C. Stevens, 31, Charing-cross—Imp. in smoke-consuming furnaces. (A com.)
1592. C. Hodgson, Ballard Rathdrum, Wicklow—Imp. in the manufacture of fuel from peat and in apparatus employed therein, parts of which are applicable to the moulding of bricks, tiles, and other like materials.
1594. J. H. Bartholf, New Oxford-street—Imp. in the construction of children's nursery chairs, and in apparatus for use in combination with the same. (A com.)

Dated 21st June, 1861.

1596. G. Turner, Rose-terrace, Brompton—Imp. in apparatus for beating eggs and for mixing or agitating other fluids, compounds, or matters.
1597. J. S. Wright, Birmingham—Imp. in reels or spools.
1599. T. R. Harding, Leeds—Imp. in the pointing of steel or other wire for the teeth of cards and in setting and fixing such or similar teeth, into sheets or fillets, which imps. are applicable to the pins for hackles and gills and in part to the pointing of needles.
1600. W. F. Henson, 15, New Cavendish-street, Portland-place—Imp. in the manufacture of floor-cloth and in the means of ornamenting the same.
1601. W. Hobson, Ellesmere-road, Sheffield—Imp. in steam hammers.
1603. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in the reproduction of forms of objects applicable to the production of printing surfaces. (A com.)

Dated 22nd June, 1861.

1605. P. H. A. C. Sapia, Paris—Imp. in instruments for measuring angles and distances.
1607. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in the manufacture of floor tiles and paving blocks. (A com.)
1609. R. Ormerod, Manchester—Certain imp. in the manufacture of ornamental or fancy ribbons and in the manufacture or apparatus connected therewith.
1610. R. Russell, Sheffield—An improved valve to regulate the passage of fluids.
1611. J. S. McArdle, Galway, Ireland—Imp. in the treatment of sea weeds for the purpose of obtaining therefrom certain valuable products.

Dated 24th June, 1861.

1616. R. Howson, Middlesbro'-on-Tees—Imp. in barometers.

Dated 25th June, 1861.

1622. J. Brown, Newport, Monmouthshire—An imp. in the manufacture of iron.
1624. C. Stevens, 31, Charing-cross—An improved noseband for stopping runaway horses. (A com.)
1626. A. Sacré, Brussels—Imp. in machinery for preparing and spinning flax or other fibrous matters.

Dated 26th June, 1861.

1630. W. Holland, Warwick—An imp. or imps. in suspending and raising and lowering window sashes.
1632. E. Abbotts, Birmingham—Imp. in fastenings for jewellery or other articles.

Patents Sealed.

[*From Gazette, July 5th*, 1861.]

July 5th.

48. P. E. Chassang.
49. G. Hallett and J. Stenhouse.
50. J. J. Welch.
58. C. N. Leroy.
59. W. E. Gedge.
94. H. Matheson.
342. W. E. Newton.
414. A. Turner.
956. A. V. Newton.

[*From Gazette, July 9th*, 1861.]

July 9th.

3096. E. Barlow, J. Newhouse, and F. Hamilton.
64. C. Newsome.
66. J. Conry.
70. C. Senior.
72. H. T. Hooper and W. Gerrans.
78. M. C. E. Page.
79. T. T. Chellingworth and J. Thurlow.
81. H. Pawson.
83. N. Ager.
89. G. Whight.
91. J. Charlton.
92. Hon. W. E. FitzMaurice.
97. C. A. Girard.
99. C. Brush.
100. J. Baldwin, jun., C. Wood, and J. Crossley.
104. J. Horsey.
122. H. Sagar.
125. J. Reading.
135. W. Clark.
136. E. Jullien.
137. M. Henry.
139. J. Townsend & J. Walker.
140. E. Argent.
166. J. B. Pascal.
189. H. Henderson.
215. G. Hallett and J. Stenhouse.
317. T. Banks and T. Morgan.
451. C. Eyland.
703. L. L. Tower.
971. J. P. Schenkl.
977. M. Smith.

Patents on which the Stamp Duty of £50 has been Paid.

[*From Gazette, July 5th*, 1861.]

June 2nd.

1495. S. Lees and J. Jaques.
1499. J. Chisholm.
1502. J. G. Jennings.
1504. J. G. Jennings and J. Lovegrove.

July 3rd.

1497. T. Restell.
1509. J. Hodgkinson.

[*From Gazette, July 9th*, 1861.]

July 4th.

1507. R. A. Brooman.

July 5th.

1510. T. Woolner.
1529. A. W. Sleigh.

July 6th.

1542. M. Scott.

Patents on which the Stamp Duty of £100 has been Paid.

[*From Gazette, July 5th*, 1861.]

July 3rd.

1469. D. Bowlas.
1484. J. Lamb.

[*From Gazette, July 9th*, 1861.]

July 4th.

1491. W. Pole.

July 5th.

1485. W. N. Nicholson.